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THE ROLE OF INSECT LIFE IN ONTARIO STREAMS AND LAKES

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There is in Ontario a water area of approximately 80,000 square miles which is about one-fifth of the total area of the province. As this water area is so great in extent the life of which it contains is significant economically as well as biologically.

In every body of water, stream, pond, or lake there is a community of living organisms the individuals of which are practically independent of life outside of the water but which are absolutely inter-dependent upon one another.

The Aquatic Insects constitute a group, the members of which enjoy a much greater freedom than their fellows. They live along with their other associates for a few weeks, months or years and then set out on an aerial tour of an altogether new world.

Just as is the case on land, the basic food supply for the aquatic community is plants. The plants of the water are of two kinds, those which are attached to the bottom and which grow only in shallow water down to a depth of twenty feet, and those which float about freely. Of these two groups the second one is by far the more important. These free floating plants which are of many kinds, are so small that it is necessary to use a microscope to see them. Collectively they constitute the plant plankton, or phytoplankton. As the plytoplankton is dependent upon sunshine, in the same way as land plants, and as sunshine penetrates water rather poorly, ninety per cent of the actively living phytoplankton is to be found in the upper thirty feet of a body of water.

Feeding upon this phytoplankton there is a host of microscopic animals which make up the animal plankton, or zooplankton. Since the animals which make up the zooplankton are not directly dependent upon sunlight, they inhabit all the strata of water from the surface to the greatest depths. They feed upon the living plants, the dead plants sinking to the bottom and the larger animals feed upon the smaller.

The individuals of both the phytoplankton and the zooplankton are constantly dying by countless millions, and the dead bodies are settling to the bottom where they form a layer of organic matter constituting a rich pasturage for a host of bottom dwelling animals.

Groups of outstanding importance among the bottom fauna are the clams and snails, the scuds such as gammarus, crayfish, oligochaetes and the nymphs and larvae of aquatic insects. The average population, by these organisms, of Lake Nipigon is 875 per square yard and of Lake Simcoe is 792 per square yard.

The largest members of the aquatic community are the fish. Fish feed by taking into their mouths food substances along with a certain amount of water. The mouth is then closed and the water is forced out between the gills.

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Most of the food substance would be carried out with the water if the spaces between the gills were not covered by comb-like structures called gill rakers. The teeth of the gill-rakers vary in size and in their spacing along the gill arch in different species of fish. The type of food which different fish can utilize is dependent upon this characteristic.

Some fish have such fine gill-rakers, placed so closely together that they can strain the plankton from the water. These constitute what are called the forage fish as they utilize the primary crop. To this group belong the ciscoes or lake herring, the minnows and the young of all species.

Another group contains fish of which the gill-rakers are not able to retain the plankton, but are able to strain out the molluscs, crayfish, insect larvae and pupae which live on the bottom. These are the bottom feeding fish such as the suckers, whitefish and sturgeon.

The carnivorous fish have large, widely-spaced gill-rakers and the adults feed almost entirely upon fish and the other larger aquatic animals. Since these fish must be swift and powerful to overtake and eat other fish they are by their very nature Game Fish such at trout, bass, maskinonge, pike and pickerel.

From the point of view of their utilization by fish and their contact with man some groups of aquatic insects are of much greater importance than others.

The aquatic diptera possesses in three families the most abundant and universally distributed aquatic insects.

The Culicidae or mosquitoes constitute a real nuisance to mankind, and in the genus Anopheles, which carries the malaria parasite, a menace to life. The mosquito larvae live in shallow stagnant water, spending most of the time at the surface, each being attached to the surface film by a breathing siphon. Several species of surface-feeding fish or top minnows such as the Guppies, Fundulus and Gambusia or Mosquito Fish feed extensively upon the larvae of the mosquito. Fish of these species are regularly employed in mosquito control work, being introduced both in small private ponds and in large areas of public water.

The species of Corethra, although resembling mosquitoes, in the adult stage, differ from them in not being able to bite. Their larvae, which are striking in appearance, are called the Phantom Larvae from their almost complete transparency. Since these larvae float about freely in the water they belong to the plankton. In small ponds they are to be seen a short distance below the surface of the water. Some species inhabit large lakes where they are found at all depths down to a hundred feet and more.

The Simuliidae or black flies are well known to anyone who has been in the Northern Ontario bush in early summer, where they make life almost unbearable. Their larvae are black and sit in colonies on rocks, sticks and leaves in shallow, swift flowing water, where they cling by means of a posterior sucking disc. These larvae spin threads from stone to stone or from stick to stick and to avoid danger can travel along these threads at incredible speed. The larvae have hairy bushes which extend out from their heads in the form of a basket constituting a plankton trap. This captures the plankton which is carried down the stream and so furnishes the larvae with a food supply.

The cocoon is glued fast to rocks at the bottom of the stream. During the latter part of the pupal stage, which lasts about two weeks, the pupa becomes

inflated with air. When the pupa finally splits open this air rises quickly to the surface as a bubble. On contact with the surface the bubble bursts and the fly is released into the air.

These black fly larvae and pupae constitute a fairly important source of food for trout. The black flies are of interest also in that they are the primary hosts for a malaria-like disease of ducks caused by a Leucocytozoon.

The Chironomidae constitute a large family of delicate flies commonly known as midges and containing among many other harmless forms the Sand-flies, Punkies, or no-see-ums which make life miserable where they occur. This family is by far the most important of the Diptera in the economy of fish life. The larvae are commonly called blood-worms because, in many species, they are red in color. They live upon the leaves and stems of aquatic plants and make burrows in the rich organic layer at the bottom of ponds and lakes, living in the shallowest of water and extending into the deepest. In Lake Nipigon the average number of Chironomid larvae per square yard is 351 where they constitute 33% of the total bottom fauna, by numbers. In Lake Simcoe it is 554, constituting 65% of the total bottom fauna.

Many fish take these larvae from the bottom as a staple article of diet, while some have regular feasts during the period of the rise of the pupae and emergence of the adults. This is particularly noticeable in trout ponds. On quiet summer nights the trout can be seen breaking the surface of the water at countless points as they pick off the pupae hanging from the surface film or the adults just emerging.

The Ephemeroptera or May flies are of tremendous importance in the economy of fresh water life. This order includes species that range from the swiftest, coldest, tiny spring fed streams to slow moving deep rivers and again in lakes from the shallowest water to depths of sixty feet and more.

Although nowhere so numerous as the Diptera, they do occur in immense numbers at certain times and places and due to their much greater size are of more significance under these conditions.

The May flies exhibit immense variation in their life histories, not only in different species but in the same species living under different conditions.

In their life history they pass through incomplete metamorphosis, each stage being called an instar. Following the final aquatic instar the May fly emerges as a sub-imago, rests upon a tree or other support and after one night emerges as an Imago or mature insect, which mates, oviposits and dies within a few hours. From the deposition of the egg to the emergence of the sub-imago is in some cases a matter of months from May to August, in many cases a period of one year and in some instances two years. During this period the May fly nymph may have as many as thirty instars.

Since both the nymph and adults are taken extensively as food by many fish these life histories are of considerable importance in the food role of the waters.

Those May flies that pass all of their nymphal stages in a few months, furnish a continuously replenished supply of food, while those which take two years to pass through their nymphal stages supply a continuously growing reser-

voir upon which fish make constant inroads.

A census of the Chironomidae and Ephemeridae population of a lake taken in November and April shows an extraordinary decrease in population during this period when few if any eggs are being deposited and when the fish are using up the food at hand as rapidly as they require it.

The Trichoptera or caddis flies are less abundant than May flies but extremely valuable as fish food both in the larval and adult stages. So much so in fact that the Duns, an English dry fly, is modelled after the caddis adult, or perhaps the May fly sub-imago, and the Deer Hair Nymph a Canadian wet fly, is modelled after the caddis larva case.

The outstanding characteristic of the caddis larva is that it builds a case of stones, sticks or shells in which it spends most of its life.

In Ontario the caddis is particularly important in small lakes and ponds where trout abound. Here the small trout may be seen to grasp a caddis larva by the head and to shake it as a dog shakes a rat, thus releasing it from its case before eating it. The larger trout however eat case and all.

Among the caddis the species of the Genus Hydropsyche are of much interest. The larvae of this species live in streams and build plankton nets between stones, to collect the plankton being carried down stream, which they use as food.

The Odonata with its two suborders the Anisoptera or Damsel flies and the Zygoptera or Dragon flies constitutes a most striking order of insects.

The nymphs of the Dragon flies which are large in size and inhabit streams and the shallow water of marshes for the most part are of considerable value as food for fish. They exhibit incomplete metamorphosis having some fifteen instars, which may take, according to the species, from one to five years. These extended life cycles guarantee a constant food supply to fish living in waters inhabited by Dragon flies.

From the extensive studies of Dr. Ide and Mr. Ricker on the insect life of Ontario streams and lakes we have obtained a vast amount of information on the characteristic insect fauna of various types of streams. From these data it is now possible to utilize the insect population of a stream as an index to the species and numbers of fish which we might expect a stream to support.

Surface living insects such as the Whirligig Beetles and Striders as well as terrestrial insects which fall on the surface of the water enter into the economy of stream life as they are taken to a great extent by surface feeders.

Insects from many other Orders have representatives in the field of Aquatic Insects. Some are of considerable importance locally and some have interesting life histories but none form such essential links in the aquatic community as those with which we have dealt which even the most superficial study of aquatic conditions must take into consideration.

NOTES ON THE NATIVE HOSTS OF SOME ORIENTAL FRUIT MOTH PARASITES

BY WM. L. PUTMAN,

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Within the last few years parasites have become of increasing importance in the control of the oriental fruit moth, *Grapholitha molesta* Busck. Dr. Van

Steenburgh, in a paper to be published in the Report of the Entomological Society of Ontario for 1934, has reviewed their importance in Ontario and has shown that *Glypta rufiscutellaris* Cress. is the predominant native species, ranking next to the introduced *Macrocentrus ancylivorus* Roh. *Cremastus minor* Cush. is of secondary importance, while the other species occur only in small numbers.

Allen and Lott (1930) were the first to show that the ragweed borer (*Epiblema strenuana* Wlk.) was a common host of *Glypta rufiscutellaris,* and this has since been confirmed by Montgomery (1933), Crawford (1933), and Pepper and Driggers (1934) over a large area in the Eastern States. During 1934 the writer made several collections of ragweed (*Ambrosia artemesiifolia*) from various sections of the Niagara fruit belt in Ontario, and from this material both *G. rufiscutellaris* and *E. strenuana* emerged in large numbers. In an orchard near St. Davids 40 per cent of the ragweed plants were infested by the first generation larvae of the borer, approximately 30 per cent of which were parasitized by *G. rufiscutellaris.* No percentages were obtained from other parts of the fruit belt, but both host and parasite were generally distributed. Emergence of the parasite from the first or summer generation of *E. strenuana* extended from August 1 to September 10. A small collection of the overwintering generation of the borer was made too late in the spring of 1934 to obtain any *G. rufiscutellaris,* but numerous empty cocoons were found, and an examination of ragweed stems from St. Davids during January of the present winter (1935) showed that approximately 8 per cent of the overwintering larvae had been parasitized by this species.

In Ontario *G. rufiscutellaris* is predominantly a parasite of the second generation of the fruit moth, only a very small proportion of the first generation being attacked. In New York State, Crawford says that the period of emergence of *G. rufiscutellaris* from overwintering *E. strenuana* was May 3 to 13 in 1931 and May 12 to 24 in 1932. At St. Davids, Ontario, all of this parasite had emerged before the first collection was made on May 14, 1934. As the second generation larvae of the fruit moth do not commence to appear until approximately the end of the first week in July, it is apparent that the first generation of *G. rufiscutellaris* must be produced from some intermediate host. During the past season at St. Davids the writer recovered an early generation of this species from two hosts, an unknown lepidopterous leaf-tier on hawthorn, and *Argyrotoxa semipurpurana* Kft., a leaf roller on red oak. From the unknown species *G. rufiscutellaris* emerged June 19 to 23; the percentage of parasitism was not obtained but appeared to be rather high. The host larvae were very abundant on certain species of hawthorn (*Crataegus* spp.) during May and early June, tying the young growth. The larvae descend and spin cocoons on or in the soil, the moths apparently not emerging until the following spring. From *A. semipurpurana, G. rufiscutellaris* emerged June 19 and 20. Neither host nor parasite were as abundant as in the case of the former species.

Specimens of *Glypta* from these two hosts were carefully compared with those from *E. strenuana* by Mr. G. S. Walley of the Entomological Branch, Ottawa, who pronounced them all to be *G. rufiscutellaris,* but no attempt was made to induce them to parasitize fruit moth larvae.

G. rufiscutellaris was also recovered from the lesser apple worm (*Grapho-*

litha prunivora Wlsh.), the cherry fruit worm (*Grapholitha packardii* Zell.), and the hickory husk borer (*Laspeyresia caryana* Fitch), but in too small numbers to be of any significance.

A few *Cremastus minor* emerged from *E. strenuana,* August 20 to September 1, but did not appear to be an abundant parasite. *Macrocentrus delicatus* Cress., which is of little importance as a fruit moth parasite in Ontario, was quite abundant on *E. strenuana,* 10 per cent of the first generation larvae being parasitized at St. Davids. Emergence occurred from August 2 to September 11. Pepper and Driggers (loc. cit.) claim that this species does not overwinter in any numbers on *E. strenuana* in New Jersey, but this does not appear to hold for Ontario. From small collections made in the spring of 1934 several *delicatus* emerged during June and from dissections of *E. strenuana* larvae made in January, 1935, 10 per cent were found parasitized by small larvae which Dr. Van Steenburgh has kindly identified as *Macrocentrus* sp. This is presumably *delicatus,* as only one example of *M. ancylivorus* has been reared from this host in Ontario.

Other minor or incidental parasites of the oriental fruit moth which were reared from other hosts during 1932 to 1934, at St. Davids, are:

PARASITE	HOST
Actia interrupta Curran	*Tortrix pallorana* Rob.
Ascogaster carpocapsae Vier.	*Carpocapsa pomonella* Linn. *Grapholitha packardii* Zell. *Grapholitha prunivora* Wlsh.
Bassus cinctus Cress.	*Gnorimoschema chenopodiella* Bsk.
Calliephialtes grapholithae (Cress.)	*Laspeyresia caryana* Fitch.
(*Dioctes*) *Inareolata obliterata* (Cress.)	*Argyresthesia oreasella* Clem. *Polychrosis viteana* Clem. *Proteoteras aesculana* Riley *Simaethis pariana* Clerck. *Xyrosaris celastrusella* Kft.
Macrocentrus laspeyresiae Mues.	*Laspeyresia caryana* Fitch
Microbracon gelechiae (Ashm.)	*Gnorimoschema chenopodiella* Bsk. *Simaethis pariana* Clerck.

The writer wishes to thank Dr. W. E. Van Steenburgh of the Dominion Parasite Laboratory, Belleville, Ontario, for the identification of parasitic larvae and for the use of his manuscript paper, from which all the data regarding the oriental fruit moth parasites were obtained; also Mr. W. A. Ross of the Dominion Entomological Laboratory, Vineland Station, Ontario, who directed the project, and Mr. G. G. Dustan of the Ontario Fruit Branch, for advice and assistance.

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NEW SPECIES OF NORTH AMERICAN SCARABAEIDAE II (COLEOP.)

BY R. E. BARRETT,

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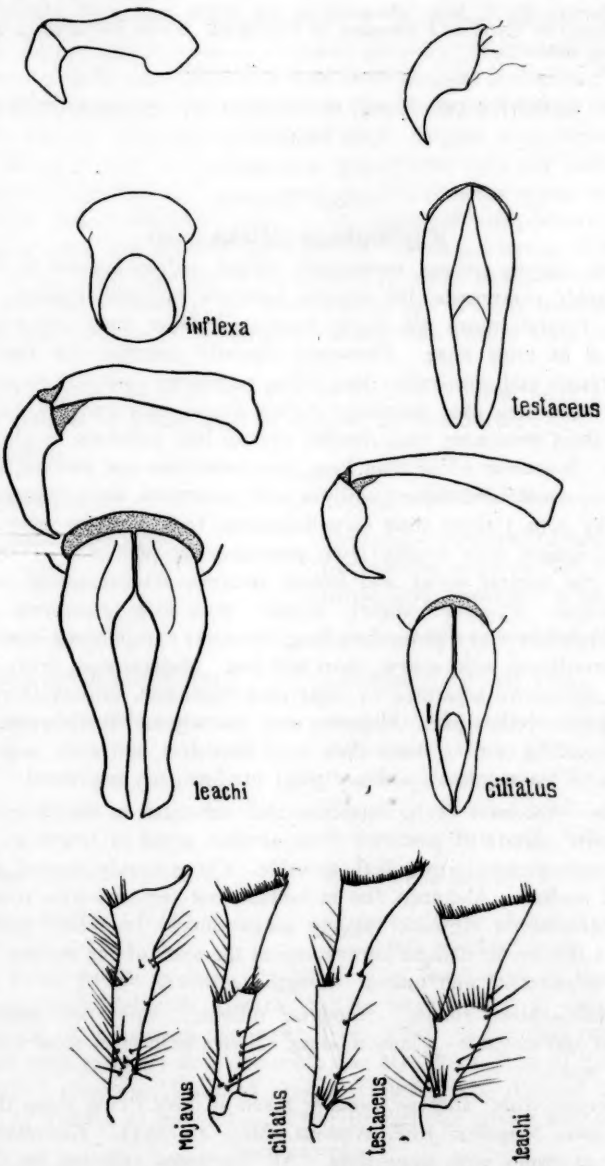
Phyllophaga inflexa n. sp.

Oval, slightly oblong, moderately robust, rufocastaneous to brown, dull. Clypeus feebly emarginate, the margin narrowly reflexed, coarsely and deeply punctured, frontal suture not deeply impressed, front more coarsely punctured and with short erect setae. Pronotum obtusely angulate, the lateral margins coarsely crenate and with rather long ciliae, punctures moderate in size separated by 2 to 3 times their own diameters slightly denser near margins, each puncture bearing a short semi-erect seta, median smooth line indistinct to absent in some specimens. Scutellum wider than long, punctures fine and shallow each bearing a short seta, evenly distributed. Elytra with punctures finer than on pronotum separated by 2 to 3 times their own diameters, each puncture with short semi-erect setae, longer setae arising from punctures on each side of the scutellum and along the sutural costae and lateral margins, sutural costae well defined, others obsolete. Pygidium slightly broader than long, punctures oblong and coarse separated by 1 to 2 times their long diameters except along base where they are almost confluent, setae sparse, short and fine. Metasternum finely and densely punctured, punctures separated by their own diameters, uniformly clothed with rather long erect yellow pile. Abdomen very sparsely and finely punctured, punctures separated by 3 to 5 times their own diameters and each bearing a short yellow seta. Last segment maxillary palpi fusiform not impressed.

Male.—Antennae of 10 segments, club sub-equal in length to segments 2 to 7 inclusive. Spurs of posterior tibiae slender, equal in length to first tarsal segment, upper slightly longer, both movable. Claws evenly curved, tooth right-angled and median. Abdomen flat at middle, last segment with transverse impression, penultimate segment vaguely longitudinally impressed and granulate at middle, a few feeble oblique impressions at the sides of the median impression. Aedeagus symmetrical and united. Length 14-18 mm.

Female.—More robust. Antennae missing. Spurs of posterior tibiae short, broad and movable. Claws missing. Elytra with erect setae more obvious. Length 19 mm.

Holotype, male; allotype, female; taken at dusk flying along the shore of Morman Lake, Mogollen Rim, Arizona, May 27, 1933. Elevation 7,000 ft. Paratypes, 41 males with same data. All specimens collected by Douglas K. Duncan of Globe, Arizona. This species should be placed in Group XII after *crenulata* Froelich, from which it may be separated by much less abundant dorsal pubescence, darker color and form of aedeagus.



NORTH AMERICAN SCARABAEIDAE.

Phobetus Lec.

A character of considerable importance in this genus is the form and ornamentation of the posterior tibia. In the various species the most divergent specific development occurs in the male, the tibiae of the female is more stoutly constructed and uniform. All drawings of the tibiae are from the male.

Phobetus leachi n. sp.

Dark, piceous rather dull, of same size and form as *comatus* Lec. Head uniformly piceous, fimbriate, clypeus and front coarsely densely and confluently punctate. Antennae of 9 segments. Pronotum fimbriate with long pile, piceous to testaceous the lighter forms usually with a large central piceous cloud, median anterior portion with large punctures which give rise to long pile, disc finely punctate with punctures separated by 2 to 3 times their own diameters. Elytra, uniformly piceous with sutural interval not darker, fimbriate, long sparse pile near the base, sutural striae distinct and complete the other striae imperfectly represented by fine closely placed punctures, intervals with coarser more widely spaced punctures. Under surface of body densely covered with long yellow pile.

Male.—Slender. Uncus present on middle tibiae. Antennal club much longer and distinctly lighter in color than scape. Length 15-17 mm.

Female.—Unknown.

Type, male; from Sonoma County, California. Collected March 1, 1929. Paratypes, 18 males with same data. All specimens collected by E. R. Leach of Piedmont, California, to whom the species is dedicated.

Phobetus ciliatus n. sp.

Oblong, testaceous, head piceous to testaceous. Head fimbriate, coarsely and confluently punctured, front with long robust setae arising from punctures, terminal segment of palpus twice as long as side when viewed from above and with a broad slightly impressed area. Antennae of 10 segments. Pronotum fimbriate, evenly and minutely punctate, without large punctures on anterior portion of disc. Elytra with sparse long pile near the base, fimbriate, sutural striae distinct and complete, the other striae represented by fine punctures, intervals sparsely punctate. Under surface of body covered with long yellow pile.

Male—Uncus present on middle tibiae. Antennal club slightly longer than the funicle. Length 12-16 mm.

Female—Antennal club shorter than funicle. Length 14 mm.

Holotype, male; allotype, female; from Avalon, Santa Catalina Island, California, March 1, 1932. Paratypes, 21 males with same data except one which was taken February 14, 1930, at Avalon. All specimens were obtained from Arthur T. McClay.

This species can most readily be separated from the other known species by the setae on the front, 10 segmented antennae and smooth anterior portion of the disc of the pronotum.

Phobetus testaceus Lec.

This is a very distinct species and only distantly related to *comatus*, being closest to *mojavus* of the previously described species. The two specimens at hand, male and female, are respectively 19 and 22 mm. long. Terminal segment of palpus over twice as long as wide when viewed from above and with distinct longitudinal impression. Male with uncus on middle tibiae. Antennal club of

female but slightly shorter than male. Antennae of both sexes of 10 segments. Disc of pronotum without large punctures on anterior part. Specimens studied were received from the collection of A. C. Davis of Takoma Park, Maryland.

A. Antennae of 9 segments, pronotum with large punctures, terminal segment of palpus without impressed area.
   1. Elytra piceous to lighter, always with darker sutural stripe, club and funicle of same color.
      a. Northern Calif., Ore., Wash. ..... *comatus* Lec.
      b. Southern Calif. ..... *sloopi* Barrett
      (Aedeagus necessary for separation.)
   2. Elytra uniformly piceous, club usually lighter than funicle. Sonoma Co., Calif. ..... *leachi* n. sp.

B. Antennae of 10 segments, pronotum without large punctures, terminal segment of palpus with impressed area.
   1. Front with long robust setae. Santa Catalina Is., Calif... *ciliatus* n. sp.
   2. Front without setae.
      a. Posterior tibiae with accessory spurs present below lower spur. Santa Cruz Is., Calif. ..... *testaceous* Lec.
      b. Posterior tibiae with accessory spurs present only above upper spur. Mojave Desert, Calif. ..... *mojavus* Barrett

THE ANATOMY OF THE REPRODUCTIVE SYSTEM OF COLEOPHORA PRUNIELLA Cl.*

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The present paper presents the results of a study of a number of dissections of the reproductive system of the cherry case bearer, *Coleophora pruniella* Cl. while making observations on the general morphology and biology of this species. The work was done while located at the Peninsular Branch Experiment Station at Sturgeon Bay, Wisconsin.

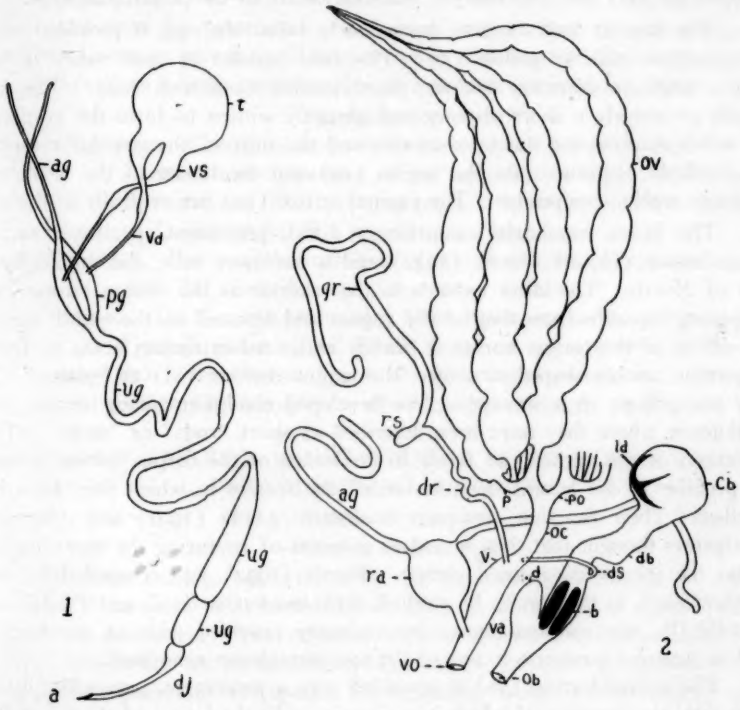
The Male (Fig., 1)

The reproductive system of the male is decidedly more simple than that of the female and its essential features agree with those described for other Lepidoptera.

Unlike the prevalent condition among the more primitive species of Lepidoptera, i.e., the Hepialidae, the testes are here united to form an unpaired, round testis (t) which is invested by a common scrotum. The vesiculae seminales (vs) are attached to the ventral surface of the testis and are to be considered enlargements of the vasa deferentia (vd). The cells lining the wall of the latter, according to Ruckes (1919), secrete the seminal fluid which forms the medium for the motile spermatozoa, although Stitz (1900) ascribed this function to the paired glands (pg). The latter are enlarged chambers of the vasa deferentia and extend apically as long, narrow, tubular accessory glands (ag). In the diagram the accessory glands are shown separated, but normally they adhere closely to each other for their entire length. The paired glands unite basally to form a long, coiled tube which is locally enlarged to form special secretory glands

*Contribution from the Department of Economic Entomology, University of Wisconsin.

(ug). The ductus ejaculatorius proceeds as a narrow duct from the lower unpaired gland and terminates in the aedeagus (a).



The reproductive systems of *Coleophora pruniella* Cl. Fig. 1—Male; Fig. 2—Female. a—aedeagus; ag—accessory gland; b—bodies in lumen; cb—corpus bursae; d—diverticulum of the ductus bursae; db—ductus bursae; dj—ductus ejaculatorius; dr—ductus receptaculi; ld—lamina dentata; ob—ostium bursae; ov—ovary; p—petiole; pg—paired glands; po—paired oviduct; ra—Reservoir of accessory gland; rs—receptaculum seminis; t—testis; ug—unpaired gland; v—vestibulum; va—vagina; vd—vas deferens; vo—vaginal orifice; vs—vesiculae seminales.

The Female (Fig. 2)

The ovaries (ov) are the most prominent parts of the female reproductive system. They lie on either side of the alimentary tract and occupy a large part of the abdominal cavity. Each ovary consists of four ovarian tubules or ovarioles which are quite firmly bound together by ramifications of the tracheae; when the latter are severed the ovarioles are easily separated from each other save their apices which are more firmly united. The ovarian terminal filaments, described in certain Lepidoptera, are entirely wanting in this species, the apex of each ovary extending freely in the body cavity. Through the transparent wall of the ovariole, the germinal epithelian, the developing eggs can clearly be seen; the more mature eggs at the lower part of the ovarioles exhibit the typical longitudinal striae. Approximately 128 eggs are present in the ovaries of a freshly emerged adult, but laboratory records based upon 18 females showed that only an average of 55 eggs are laid during the entire period of oviposition. At the time of emergence

there is a nearly mature egg at the base of each ovariole. Each egg is followed by a series of successively smaller eggs to the terminal region where they can be distinguished only with difficulty. The ovaries are of the polytrophic type.

The base of each ovariole, immediately below the egg, is provided with a short, narrow stalk or petiole (p). The four petioles of each ovary unite to form a single or common oviduct, the oviductus communis (oc). The latter extends posteriorly a short distance and abruptly widens to form the vestibulum (v) which receives the ductus seminalis and the duct of the seminal receptacle. The vestibula continues into the vagina (va) and the lumen of the latter communicates with the ovipositor. The vaginal orifice (vo) lies ventrally to the anus.

The bursa copulatrix comprises a distal, prominent, pyriform sac, the corpus bursae (cb) of Norris (1932) and a narrower tube, the ductus bursae (db) of Norris. The latter extends to the exterior as the ostium bursae (ob), an opening separate from that of the vagina and situated on the eighth sternite. The intima of the corpus bursae is heavily chitinized in certain areas to form a conspicuous anchor-shaped structure, the lamina dentata (ld) or "plates." The latter are present in a somewhat less developed condition among certain other Lepidoptera where they have been described as short "rods" or "teeth." Three projections of the anchor end freely in the lumen of the corpus bursae, a condition peculiar to the lamina dentata for all the species in which they have been described. Their function, however, is obscure. Stitz (1901) and other early investigators thought that they served as a means of rupturing the spermatophore so that the spermatozoa could escape. Norris (1932) was compelled to reject this view since, in the species he studied, *Ephestia kuehnella* Z. and *Plodia interpunctella* Hb., the spermatophores were already provided with an opening; nor could he discover a rupture in any of the spermatophores examined.

The ductus bursae (db) is provided with a prominent, pouch-like diverticulum (d), the function of which is not known. In the lumen of the bursa duct, just above the diverticulum, lie two large, dark-colored, oblong bodies, the function of which likewise is not known. They persist even after boiling in 10 per cent potassium hydroxide.

The ductus seminalis (ds) proceeds from the ductus bursae at the base of the bursa sac as a narrow tube and opens into the vestibulum on its dorsal surface. The seminal duct serves as a passageway for the spermatozoa from the bursa sac to the lumen of the vestibulum where the eggs are very likely fertilized.

The receptaculum seminis (rs) is an elongated sac which opens into the vestibulum near and opposite the opening of the seminal duct, by means of the spiral duct or ductus receptaculi (dr). The latter is visible, in whole mounts in balsam, only under the high power of the microscope and even then it is difficult to discern. From the apical end of the recaptaculum seminis proceeds the elongated tubular gland, the glandula receptaculi (gr) which is nearly twice the diameter of the ductus receptaculi. According to Norris (1932) and others the secretion of the glandula receptaculi is thought to provide a nutritive medium for the sperms. The accessory or colleterial glands (ag) are represented by a pair of long, slender ducts which empty into a common, enlarged sac or reservoir (ra). The accessory glands are narrowly constricted before uniting with the reservoir;

the latter joins the vagina by a short canal. The secretion of the accessory glands is stored in the reservoir from whence it is discharged into the lumen of the vagina where it serves to form an adhesive film over the eggs enabling them to be cemented upon the substratum. In balsam preparations, the yellowish secretion of the accessory glands could be detected in the lumen of the latter, especially in the reservoir as a large coagulated mass, and in the duct leading to the vagina.

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FIVE NEW SPECIES OF BRACONIDAE WITH HOST RECORDS OF ADDITIONAL SPECIES*

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In recent rearings by officers of the Entomological Branch several new species of Braconidae have been secured as well as records of species hitherto little known in Canada. The writer wishes to express his indebtedness to Dr. C. W. F. Muesebeck for his assistance in examining three of the species described below. Paratypes of all the species are deposited in the United States National Museum.

Earinus zeirapherae n. sp.

Female. Length 4 mm. Face shining, impunctate, slightly elevated down the median line; temples moderately broad and receding; cheeks rather bulging; ocellocular line slightly shorter than twice the diameter of a lateral ocellus and distinctly less than postocellar line; antennae 34 segmented, flagellum rather slender, all segments distinctly longer than broad; mesoscutum shining not distinctly punctate; mesopleura shining, impunctate; propodeum smooth with two median longitudinal carinae which converge slightly anteriorly and posteriorly and are confused somewhat at the middle by a few fine oblique or transverse rugulae; head and thorax clothed with rather long greyish pile; radius arising from slightly before middle of stigma; second cubital cell almost twice as high as long, with the second abcissa of radius scarcely as long as first and the second intercubitus curved outwardly; nervulus slightly beyond basal vein; first abcissa of mediella longer than second; nervellus angled and emitting a distinct discoidella; anterior femora somewhat swollen; posterior femora rather broad and flattened, tibiae and tarsi rather long and slender; abdomen nearly flat above and with sides almost parallel, narrowing a little basally and apically;

*Contribution from the Division of Systematic Entomology, Entomological Branch, Department of Agriculture, Ottawa.

first tergite polished except for slight roughness on either side, dorsal keels not prominent, distinct only at base; ovipositor sheaths broad, strongly hairy and about as long as thorax and abdomen..

Body entirely black; tegulae dark brown; wings dusky; legs testaceous, front and middle coxae mostly, all trochanters faintly, hind coxae basally and tips of anterior tarsi blackish; posterior tibia dirty whitish with a narrow subbasal annulus and the apical half blackish; hind tarsi blackish.

Male—Resembles the female closely with the blackish suffusions a little more extensive on the legs.

Holotype—♀, Grand River, N. S., May 11, 1932 (M. L. Prebble) No. 3847 in the Canadian National Collection, Ottawa, Ont.

Allotype—♂, Same data as holotype.

Paratypes—2♀♀, May 11, ♀ May 12, 1932, Grand River, N. S. (M. L. Prebble).

Host—All the above mentioned specimens were reared by Mr. Prebble from *Zeiraphera ratzeburgiana* Sax. under Experiment No. 18761-5.

Cocoons—White, cylindrical silken cocoons somewhat resembling those of the genus *Microgaster;* solitary.

Notes—The above species conforms closely with Muesebeck's diagnosis of the genus (Proc. U. S. N. M. LXIX, Art. 16, p. 5, 1927). *E. limitaris* Say, the only other known North American species may be easily distinguished from *zeirapherae* by its larger size, hyaline wings, broader second cubital cell and shorter ovipositor sheath which in length does not exceed the abdomen. In *E. limitaris* the face is also usually distinctly punctate.

Microgaster peroneae n. sp.

Traces to Couplet 14 in Muesebeck's key to the North American species (Proc. U. S. N. M. LXI, Art. 15, p. 21, 1922). Because of the bicolored front and middle coxae and the black hind coxae and pale tegulae the species is difficult to trace beyond this point in the above key. It appears to be rather closely related to *gelechiae* Riley but specimens of that species before me differ in having the head noticeably thicker antero-posteriorly with the temples broader and less strongly sloping inwards, the hind coxae are black only basally and the hind tarsi are wholly testaceous. Among the remaining species in the key it can only be confused with *carinata* Pack. and *epagoges* Gahan. *Carinata* has black tegulae and black trochanters and the abdomen is polished beyond the second segment; in *peroneae* the tegulae and trochanters are pale and the third tergite is sculptured at least at the base. *Epagoges* has broadly rounded less strongly sloping temples and the hind tibiae fuscous except narrowly at the base. The species is described as follows:

Female—Length 3.5 mm. Face slightly broader than long, with numerous shallow poorly defined punctures, granularly sculptured, a short low median carina below antennal fossae; temples strongly rounded and sloping inwards, punctate with fine vertical rugulae between punctures; antennae distinctly longer than body; mesoscutum shining, unevenly punctate, punctures dense and often confluent along region of notauli, shallow and sparse along either side, posteriorly and in middle; scutellum almost flat, polished with only a few small punctures laterally; mesopleura with rather large shallow punctures in front and below, the upper,

median and posterior portion smooth and polished, impunctate; propodeum coarsely irregularly rugose with a prominent median and strong lateral longitudinal carinae; stigma broad, almost as long as metacarpus; radius arising distinctly beyond middle of stigma, directed outward, slightly longer than first intercubitus; first abcissa of discoideus subequal to second; posterior coxae half as long as thorax; shining, punctate, with oblong punctate flattened area on outer surface at base; inner spur of middle tibia as long as middle metatarsus; inner spur of posterior tibia five-eights as long as posterior metatarsus; abdomen twice as long as broad and as long as thorax; first tergite at apex nearly one-third broader than long, distinctly broadening posteriorly, entirely reticulately rugose; second tergite three times as broad as long, sculptured similar to first but a little less coarsely; third tergite rugulose on basal half, unsculptured beyond; suture between second and third tergites straight and crenulate; dorsum of abdomen beyond third tergite smooth and shining; sheaths of ovipositor slender at base, broadening posteriorly, projecting two-thirds length of abdomen; hypopygium not surpassing apex of last dorsal abdominal segment.

Black; palpi yellowish; antennae black; tegulae and wing bases testaceous, the latter with a brownish spot; wings faintly dusky; stigma brown; front coxae brownish-black on basal half, testaceous beyond; middle coxae largely testaceous with blackish confined to region above near point of attachment to thorax; hind coxae black except for extreme apices which are brownish below; remainder of front and middle legs, hind femora and tibia reddish testaceous; hind tarsi brownish except for yellowish basal half of metatarsus; the hind tibia with a trace of brownish at the apex; abdomen black above except for small testaceous spot at middle of lateral margin of third segment; first, second and third and spot on fourth sternites largely testaceous; ovipositor sheaths black.

Male—Length 3 mm. Like the female but with the front and middle coxae black except at apices.

Holotype—♀, Grand River, N. S., June 2, 1932 (M. L. Prebble) No. 3849 in the Canadian National Collection, Ottawa, Ont.

Allotype—♂, Grand River, N. S., June 4, 1932 (M. L. Prebble).

Paratypes—12 ♂ ♂, 21 ♀ ♀, Grand River, N. S., May 26 - June 4, 1932 (M. L. Prebble).

Host—The above series all reared from *Peronea variana*.

Cocoons—Parchment white; solitary.

Notes—The tegulae of the males vary in color from testaceous to distinctly brown in a few instances and in the females a few specimens are pale brownish. The color of the front and middle coxae varies somewhat in both sexes, the range being slightly greater in the females where the palest examples have a little less than the basal half of front and middle coxae black.

Microgaster leechi n. sp.

Differs from *gelechiae* Riley in having the posterior coxae pale throughout, the posterior tibia with a blackish band at the apex and the posterior tarsi entirely blackish; the stigma is longer and narrower than in *gelechiae* and the mesopleura bear a weakly crenulate furrow somewhat as in *rubricoxa* Prov. The anterior wings are only faintly subhyaline apically but the species may be distinguished from ***harnedi*** Mues. by the conspicuous testaceous markings on the

abdomen above and the uniformly testaceous venter.

Female—Length 4.75 mm. Face obliquely transversely rugulose on either side becoming rugulose-punctate medially with a distinct polished median carina extending from antennal fossae to base of clypeus, the latter separated from face; vertex and temples shining, the latter shallowly punctate and somewhat striate; antennae fully as long as body; mesonotum densely punctate anteriorly, posteriorly the punctures becoming sparser, shallower and finally obsolete with the surface correspondingly more shining; scutellum with disk shining, impunctate, groove in front deep, foveolate; propodeum coarsely rugose with a strong median longitudinal carina, mesopleura mostly polished and impunctate on upper half with only faint traces of sculpturing, the polished area limited below by a shallow longitudinal foveolate line, the region below and sternum with numerous distinct punctures; stigma slightly shorter than metacarpus and a little more than twice as long as broad; radius arising much beyond middle of stigma, tending distinctly outward and slightly bent, distinctly longer than first intercubitus; the unpigmented second abcissa of radius bending at its basal third so that radial cell is unusually long and narrow in apical two-thirds; inner spur of middle tibia equal in length to metatarsus; inner spur of posterior tibia approximately two-thirds as long as metatarsus; hind femora one-fourth longer than hind coxae; abdomen broad, stout, as long as thorax; the first tergite very large, gradually broadening to apex where it is a little broader than long, very coarsely rugose except for small polished basin at middle of base; second tergite longer than third, two and one-half times as broad as long, coarsely rugose; third tergite with scattered punctures and somewhat striate on basal half, polished beyond; the following tergites smooth, impunctate; sheath of ovipositor broadening gradually between base and middle, thence with sides parallel.

Black; palpi pale yellow, scape dull testaceous with a narrow black line on outer side; flagellum above yellowish-brown becoming blackish at apex, below dull testaceous; tegulae and wing bases yellowish; stigma brown with basal spot and anterior margin dull testaceous; front and middle coxae and all trochanters pale yellow; remainder of front and middle legs yellowish-stramineous, hind coxae testaceous; hind femora and hind tibia except for blackish apices of latter, reddish testaceous; hind tarsi blackish; venter of abdomen uniformly reddish testaceous; first two abdominal tergites black, third tergite largely black but with postero-lateral angles and narrow posterior margin pale reddish testaceous, the following tergites have the black confined to a narrow median patch which forms an irregular median stripe on tergites three to eight; the eighth tergite has the posterior margin black so that viewed from below the anal orifice is surrounded by a blackish horse-shoe shaped band; sheath of ovipositor black.

Holotype—♀, Steelhead, B. C., July 15, 1933 (H. B. Leech) No. 3851 in the Canadian National Collection, Ottawa, Ont.

Paratypes—3 ♀ ♀, same data as holotype.

Host—Pyrausta pertextalis Led.

Cocoons—Parchment white; solitary.

Microbracon laspeyresiae n. sp.

Traces to couplet 63 in Muesebeck's key (Proc. U. S. N. M. LXVII, Art. 8, p. 16, 1925) and agrees in part with the characters assigned to *aequalis*

(Prov.) but differs from that species in having the antennae more slender, the wings distinctly dusky, the ovipositor sheath at least as long as abdomen beyond the first tergite and the mesopleura and metapleura largely reddish testaceous.

Female—Length 3 mm. Head rather thick at insertion of antennae; temples rounded only gradually receding behind eyes; malar space less than two-thirds length of first segment of flagellum; transverse diameter of opening between clypeus and mandibles three times as long as the malar space and almost two-thirds as wide as face; ocellocular line almost three times as long as diameter of ocellus; antennae 33 segmented, all the flagellar segments at least twice as long as broad; margin of clypeus projecting distinctly forward; face and frons finely sculptured; thorax smooth and polished; propodeum convex, polished, without sculpture, with a short stub of a median carina posteriorly which is furcate briefly at its anterior extremity; second abcissa of radius nearly three times as long as first and not quite two-thirds as long as third; abdomen moderately broad; first tergite with the mid apical portion rugulose, a strong carina running from spiracle to apex with the area on either side strongly concave, the outer concavity extending forward to the spiracle; second tergite shining, its basal half with fine irregular rugulae, the apical portion faintly sculptured; suture between second and third tergites moderately impressed and with shallow foveae; tergites two, three and four of about equal length, tergites beyond two shining and only faintly reticulately sculptured; ovipositor sheath as long as dorsum of abdomen beyond first tergite.

Reddish yellow; head yellowish; ocellar triangle black with blackish shading on frons extending to eye on either side; vertex, temples and occiput above blackish; palpi pale yellow; mesoscutum, scutellum and somewhat more than basal half of propodeum above black; prothorax laterally and ventrally, mesopleura anteriorly and mesosternum blackish; tegulae and legs bright reddish yellow with the hind tibia in apical half and entire hind tarsi blackish; abdomen bright reddish yellow; sheath of ovipositor black; stigma dark brown; membrane pale brown with an oblique clear streak in first cubital and second discoidal cells.

Male—In general resembles the female closely but smaller in size (length 2 mm.) and with the three apical abdominal tergites suffused with blackish.

Holotype—♀, St. Davids, Ont., Aug. 23, 1933 (Wm. L. Putman) No. 3850 in the Canadian National Collection, Ottawa, Ont.

Allotype—Same data as holotype.

Paratypes—3 ♂ ♂, 10 ♀ ♀, St. Davids, Ont., Aug. 23—September 18, 1933 (Wm. L. Putman); 2 ♂ ♂, 5 ♀ ♀, St. Davids, Ont. June 4-11, 1934 (Wm. L. Putman).

Host—Laspeyresia caryana Fitch.

Apanteles solenobiae n. sp.

Traces to *fumiferanae* Vier. in Muesebeck's table to the nearctic species (Proc. U. S. N. M. LVIII, 490, 1921). Differs from *fumiferanae* in having the stigma brown with a large pale spot at base, the hind femora not fuscous at apices, the mesopleura only narrowly punctate in front with their remaining surface highly polished and impunctate and the nervellus not strongly curved toward the base of wing.

Female—Length 2.7 mm. Face slightly broader than long, obscurely finely punctate, shining; vertex, temples and cheeks more heavily punctate and subopaque; mesoscutum shining, punctures numerous, shallow, more dense in front and along region of notauli, sparser along median line; impunctate, polished on small region adjacent scutellar foveae; disk of scutellum almost flat, polished impunctate beyond; propodeum rather shining with shallow scattered punctures anteriorly; areola indicated as a polished impunctate area, longitudinal carinae distinct posteriorly, region lateral to carinae concave, with fine carinulae radiating from the prominent blunt apical angle; metacarpus as long as stimga; radius distinctly longer than transverse cubitus and making a very obtuse angle with the latter; nervellus only slightly curved toward base of wing; posterior coxae shining with fine punctures below; inner and outer hind tibial spines slightly unequal, the longer half as long as metatarsus; abdomen broad, half as broad as long, almost as long as thorax; first tergite nearly as broad as long, sides slightly curved, almost parallel, median longitudinal depression on posterior half well defined, surface shining finely and irregularly longitudinally rugulose; second tergite short, nearly four times as broad as long, shining, faintly rugulose; remaining tergites faintly sculptured with metallic reflections; ovipositor sheaths slightly shorter than abdomen.

Black; palpi yellowish, apical segment of maxillary palpus brownish; antennae entirely black; tegulae dark brown; stigma brown with a large whitish translucent spot at base and faint pale dot at apex; all coxae black; legs otherwise reddish stramineous, the hind tibia with a trace of brownish at apex, hind metatarsus pale brown on apical half, remaining segments of hind tarsus pale brownish.

Holotype—♀, Old Chelsea, Que., April 30, 1933 (G. S. Walley) No. 3848 in the Canadian National Collection, Ottawa, Ont.

Paratype—♀, Queen's Park, Aylmer, Que., May 11, 1932 (G. S. Walley).

Host—Both specimens reared from *Solenobia walshella* Clem.

Cocoons—Whitish-translucent, within the larval case of the host; solitary.

Bassus calcaratus (Cress.)

This species has been reported by Muesebeck (1927) from a number of localities in Eastern United States where it has been reared as a parasite of *Psilocorsis* sp., *Acrobasis caryivorella* Rag. and *Acrobasis betulella* Hulst. I do not know of it having been recorded from Canada. A male and a female before me have been reared from *Acrobasis rubrifasciella* Pack. at Bobcaygeon, Ont., July 13, 19, 1932 (J. McDunnough). I have reared two females from *Acrobasis comptoniella* Hulst., Mer Bleue, Ottawa, Ont., July 22, 25, 1933, and a series of one male and five females from the same host from Kazabazua, Que., July 15-19, 1933.

Bassus annulipes (Cress.)

One female is at hand from Bobcaygeon, Ont., July 7, 1932 (J. McDunnough) reared from an unidentified microlepidopterous larva feeding on wild gooseberry. This specimen has the head and abdomen entirely black with the reddish on the thorax confined to the sternum and lower half of mesopleura and the metapleura. A second female with entirely black body was reared from *Acrobasis* sp. (feeding on *Ostrya*) at Bobcaygeon, July 1, 1932 (J. McDunnough).

Bassus atripes (Cress.)

Two females and twelve males are in the National Collection from Sum-

merland, B. C., September 14-16, 1931 (A. N. Gartrell). The species has been previously recorded from Colorado and New Mexico (Muesebeck, 1927). The host is not known.

Bassus cinctus

Ten females were reared from larvae of *Haploptilia limosipenella* Dup. which fed on birch at Bobcaygeon, Ont. The parasites emerged over a period from July 25 to August 8, 1932 (J. McDunnough). A single female was reared at Bobcaygeon, Ont., June 30, 1932 (J. McDunnough) from a species of *Salebria* found feeding on *Myrica*, and one female was obtained by Dr. McDunnough at Bobcaygeon, Ont., July 29, 1932, from a larva of *Peronea*, probably *Peronea cornanum*.

NOTES ON COLLECTING DRYOPIDAE (COLEOPTERA)*

BY PAUL N. MUSGRAVE,
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Increasing interest in limnology, aquatic biology and related sciences, has been one of the main factors in turning the attention of systematic coleopterists to this family of small beetles. Many new species have been added to the catalogue recently, and it seems probable that there are many more nearctic species yet to be described. It is with the idea of fostering the growing interest in this group that the following notes are offered from an experience of several years' searching for these small, slow-moving, inconspicuous beetles.

Although members of this family (Dryopidae at present, but formerly know as Parnidae) are often called "Riffle Beetles" they are not confined to the rapids of streams at all. It is true that most species prefer comparatively swift water, but many do not necessarily demand running water for a comfortable existence at all. *Limnius tardellus* Fall is often taken in company with the larvae of Simulidae, clinging to the ledge of stone over which flows a great volume of water, which forms a mountain waterfall. In this situation the extremely large claws are invaluable, as the insect slowly crawls through the swift current. *Elmis 4-notata* Say, on the other hand, is, at times, taken in company with *Ranatra* and *Notonecta*, under freshwater pond conditions. Different genera apparently prefer different conditions. *Stenelmis* is usually found in the sand and debris under and between stones in the swifter parts of rivers and creeks, while *Limnius* seems to like the smaller streams. *Macronychus* and *Ancyronyx* cling to the undersides of sunken logs, but *Psephenus* takes to stones. *Elmis pusilla* Lec. is taken in Florida clinging to the roots of the water hyacinth, while in West Virginia it is often taken on the hand screen from stone riffles.

The generalizations just given apply to adults, but in most cases the larvae are also found in the same situations.

To be more specific, how then may one confidently expect to find Dryopidae and collect them with economic use of time and energy? Three main methods of taking them have been found successful and will be described.

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*Contribution from the Department of Biology, West Virginia University, Morgantown, W. Va.

(1) HAND SCREEN METHOD. This method can be used in any stream that has riffles which are not too deep. Although the method has been used for collecting aquatic insects for many years it may be helpful to give a description of a hand screen. Needham and Needham (Guide to the Study of Fresh-Water Biology) give the following description of a hand screen: "Hand screen for stream collecting — S (Fig. 1) is a sheet of wire screen 1 x 2 feet, woven edge below. The opposite edge, if not also woven, should be folded neatly, leaving no projecting wire-ends to prick fingers. The folded ends of the cloth are inserted in slots sawed in the handles and nailed fast there." This piece of apparatus is easily made but may be purchased from an entomological supply house if desired. Galvanized screen, size 16 to 1, that is, sixteen wires to the inch, has shown best results for the writer although larger or smaller mesh can be used with good results. Because of the color factor, galvanized screen is preferred to either copper or black, as most Dryopidae are black and are more easily seen against the lighter background.

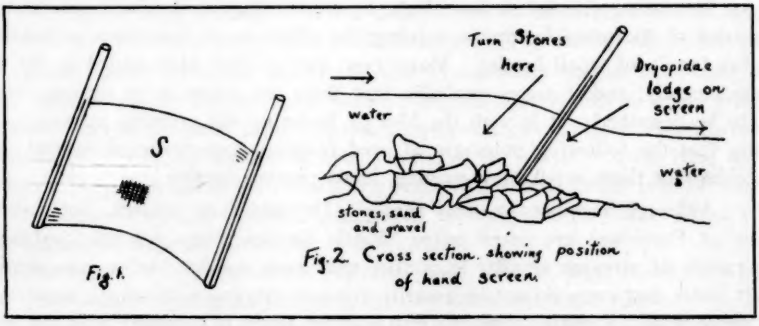

Figure 2 shows how the screen is placed in the riffle. Two people can best work the screen, one holding and the other turning stones; but with a little practice one person can obtain very good results. When one is collecting alone, the sand and stones on the bottom must be moved by the feet while the screen handles are held by the hands. Stirring the larger stones serves for some species but in order to take *Stenelmis* and *Heterelmis* one needs to disturb the sand and gravel. In a good stream one can often take eight or ten species, the record in West Virginia being twelve. Ordinarily a few seconds stirring the bottom will produce several specimens, and when the screen is carefully removed from the water the beetles may be seen slowly moving over or through the mesh of the screen. Because these beetles are truly aquatic they move more rapidly as they begin to dry out, although they can never be said to move with any great speed. The most successful way to find them is to place the screen on a large dry stone, on the stream bank, or even on the top of a small bush, allowing the water to run off. Of course, there will be a great variety of aquatic larvae, but it will be easy to distinguish the adult Dryopids. After a specimen has been located, the next step is to transfer it by means of a pair of weak forceps to a vial of 95% alcohol. Use "weak" forceps in order not to injure the specimens, and 95% alcohol because in collecting aquatics a certain amount of water is carried over

by the forceps. The alcohol should be about 80% when specimens are stored. If only half a dozen specimens are placed in a vial of 95%, sufficient water should be added to bring the solution to 80%. If the alcohol is too strong the specimens become brittle; if too weak they become soft, the thorax breaks off, the abdomen becomes distended, or the elytra misplaced. If, when in the field, a vial is entirely filled with specimens, thus reducing the percentage of alcohol below the safety point, the diluted liquid should be replaced before the vial is permanently stored. When the alcohol is right, specimens will be in as good condition for mounting after five years as when first collected. Of course, when collecting in alcohol no killing bottle is necessary. A separate vial should be used for each stream or location. After collecting at a location a label giving the name of stream, data, etc., is made with a soft pencil and placed in the alcohol with the specimens. This description sounds rather complicated, perhaps; but a few minutes with the screen in a riffle allows for the complete mastery of the method.

(2) SUBMERGED LOG METHOD. This method is very simple and requires no special equipment other than the forceps and vial of alcohol. Most any stream will show many water-logged pieces of wood. Any wood that has been lodged at one place for a few days will be a good place for Dryopidae but the ideal location is a half-rotted cross-tie or fence post. The method is to remove the timber from the water, turn it upside down and allow the water to run off. A careful search will usually discover the beetles slowly crawling into a crevice or in some way seeking a hiding place. Submerged stones also supply a few specimens under certain circumstances.

(3) FLOATING ROOT METHOD. This method is simply looking for roots from willows, etc., which float between the surface and the bottom of the stream. A bunch of these roots placed on a dry rock or other light background and allowed to dry out, often will produce a goodly number of Dryopids. Aquatic moss from submerged stones in swift streams also furnishes good collecting.

It is not the aim of this paper to leave the impression that there are only three methods of taking Dryopidae, but these methods have been particularly successful with the writer. *Helichus* and *Stenelmis* come readily to light in West Virginia and other genera are taken in the South and West. Many specimens have been taken from the stomachs of trout. Carter in Australia writes that one species described by him was first sent him by an ichthyologist. After one learns where the specimens are to be found methods for collecting are easy enough to devise.

Most Dryopidae are very small (1-10 mm.), and since they are sluggish in their motions they are difficult to see until the water has to a large extent drained off. One dip with the screen, or one log pulled out of the water, often will supply a collecting "ground" for several minutes. Place the screen in some comfortable position and then wait for the beetles to move. Leaves and trash should be looked over and discarded. Better results are obtained by carefully examining a few screens, logs or bunches of roots, than by hurriedly looking over several.

No paper of this type is complete without an offer to identify material. I shall be glad to correspond with anyone who has material for determination, or with anyone interested in this group.

BOOK NOTICES

Field Book of Insects by F. E. Lutz, 3rd Edition. G. P. Putnam's Sons, New York, 1935. Price $3.50.

This new and, according to the author, probably last edition of the well-known and popular "Field Book" has just come to hand. It has been entirely rewritten and includes much additional matter, notably concerning the insect fauna of the western and southwestern United States. The nomenclature has been brought up to date as far as was consistent with the popular nature of the volume and from the viewpoint of causing as little confusion as possible in the minds of the readers. There are about 800 illustrations, including 22 colored plates. Written in the author's inimitable style the work can be highly recommended to all lovers of nature who wish to extend their knowledge concerning these fascinating members of the animal kingdom.

Studies in North American Trichoptera, 2, Limnephilidae, by Lorus J. Milne. Privately published, Cambridge, Mass., 1935. Price 80 cents.

Consists of a key, check-list and index to the North American genera and species of Limnephilidae with full synonymy based on a study of the type material. Sixteen new species are briefly indicated in the keys.

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